A Parametric Review of Bibliometric Studies Related to COVID-19

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ABSTRACT: *Bibliometrics is an important tool originated in the library and information science community that can be used to measure the research output. Researchers in various fields have extensively used it because of its immense utility. Last year, as COVID-19 hit the globe, researchers of various, be it medical domain, library science, etc., started to perform a chain of bibliometric studies. The present study used the SCOPUS database as a source of data and identified 39 bibliometric studies (BS) related to COVID-19. These 39 BS were studied based on two sets of parameters, namely general and granular. The study revealed that though the 39 BS were performed from different points of view. But it was seen that the journal Library Philosophy and Practice had published six among these 39 BS. It was observed that various medical literature oriented databases like MEDLINE and even general databases like WOS, SCOPUS which cover a variety of subjects, were used for the studies. Data was collected using a variety of strings, with a different time-span (50 years, 20 years, 3 months, etc.) in various formats like CSV, XLS, BibTxt, txt, etc. To process, analyze, and visualize the data various software were used like Excel, Python, SPSS, VOsviewer, CiteSpace to name a few. The number of articles varied because of the number of databases adopted, purpose, time-span and even the string used for the study. The most dominant document type was an article and the most productive subject area was medicine or virology. In 13 studies, it was observed that the University of Hong Kong was the most productive organization, and Yuen Kwok-yung was their most productive author. 20 BS found the most article producing countries was USA, whereas 13 found China to be the most prolific. 8 BS found the Journal of virology as the most producing source, whereas 3 BS found the Journal of Medical Virology the most producing source. For the collaboration network, various elements authors/countries/organizations/keywords/co-citations/citations were used to create the visualization network.*

Keywords: Parametric Review, Bibliometric, COVID-19, COVID, Coronavirus, SARS-CoV-2

Received: 2 November 2022, Revised 19 December 2022, Accepted 15 January 2023

DOI: 10.6025/stm/2023/4/1/6-26

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1. Introduction

COVID-19 pandemic has affected the whole world in a way that the human race could not have fathomed. The pandemic started in Wuhan city, China and spread all over the world in a matter of months which brought the world to stand still.[1] The extensive research in the area allowed the scientist to understand the virus in a much more efficient way and provide an explanation for the community.[2] The disease was declared a pandemic by the World Health Organization(WHO) in March 2020.[3] Once the disease was declared a pandemic, all the countries were put on lockdown, but the research community was constantly putting efforts to gain more knowledge about the virus. Thus the immediate response of the community was performing the research on COVID-19 and then publishing it. It also allowed the scientists working on the vaccines to carry out the research in inappropriate directions, which resulted in the development of the vaccines for the diseases. The research community also carried the research related to COVID-19 from various aspects as well. All these multifaceted studies led to an enormous amount of publications in the field of COVID-19 research. To study the immense amount of literature on any topic, the library and information science domain has provided a tool called bibliometrics that tries to measure the research trend by utilizing quantitative indicators.[4, 5] There have been numerous studies where bibliometrics has been used as a tool to estimate the research trend of various pinpointed topics of interest like ontology construction process[6]; altmetrics[7]; 3D-printing[8], etc. Similarly, bibliometrics was utilized heavily to study the research trend of COVID-19 and a plethora of works related to bibliometric studies (BS) of COVID-19 were published. Thus, there was a need to study these plethoras of bibliometric studies and present them concisely so that the scientific community involved in such studies can identify, explore the research gaps in the field, and know the trend of research until now.

2. Literature Review

In the course of the literature review, few works were identified where the BS on specific topics or BS of a journal were reviewed or evaluated as well for instance, Koseoglu et al.[9] evaluated the bibliometrics studies done in the tourism domain to elucidate the upcoming themes and presented crucial pathways for future research in the field; Pereira et al.[10] analyzed the research trend and development of the bibliometrics studies in the administration domain by taking into account the articles published in international journals, between the years 1998-2017; Kevin et al.[11] reviewed a total of 82 bibliometrics studies on single journal that were published between the year 1998-2008 by grouping them into the fields like Arts, Humanities and Social Sciences, Medical and Health Sciences, Sciences and Technology and Library and Information Sciences; Tiew[12] reviewed 102 bibliometrics studies on single journal that were encompassed by Library and Information Science Abstracts (LISA) plus and Current Research in Library and Information Science (CRLIS) databases. There have been attempts where researchers tried to review a specific topic of study with the help of parameters to provide a holistic view of the topic. Reviews of such kind can generally be seen on software or software-related products and few such works have been discussed here. For instance, Moral-Muñoz et al.[13] performed a comparative review of the various software tools that are used for bibliometric and scientometric analysis based on various features. Mahato and Gajbe[14] performed a comparative study of open-source data repository software based on extracted criteria and similarly, Amorim et al.[15]; Gajbe et al.[16] compared various research data management platforms based on parameters. Sinha and Dutta[17] identified the core literature available on flood ontologies and reviewed the flood ontologies based on various extracted parameters from the available literature. A lot of surveys or comparisons on ontology development methodologies like Corcho et al.[18]; Simperl and Luczak-Rösch[19]; were also performed using various criteria for providing a holistic review of the methodologies. Tiwari and Madalli[20] reviewed the various maturity models for library services and management based on the various extracted and proposed parameters. The literature review also revealed that there had been only one attempt previously where the review of BS related to COVID-19 has been performed by using the databases like Scopus, Web of Science, and Google Scholar; however, the amount of literature was restricted to 30[21] whereas the present study although limited to only a single database Scopus, still analyzes 39 BS related to COVID-19. Additionally, the current study provides a list of standard parameters as well as their definitions which can be utilized by the research community for

studying BS in other domains.

3. The Objective of the Study

• To locate the published bibliometric studies related to COVID-19 and review based on extracted parameters in order to elucidate the basic idea, scope, and exhaustiveness of the studies.

• To provide a general methodology and list of parameters for reviewing existing bibliometric studies in any topic or domain of interest like the library, information science, and mathematics.

4. Data and Methodology

A review on specific studies provides a holistic view about them. The methodology here has been inspired by Camacho and Alves-Souza[22] ; Sinha and Dutta.[17] The blueprint of the methodology is similar; however, in few places, it has been modified to suit the study. The methodology is compartmentalized into phase one-literature acquisition and phase two- parametric review of BS. The two phases have been discussed in details here:

4.1. Phase one: Literature Acquisition

In order to perform a review of BS related to COVID-19, the first and foremost thing was to identify and acquire the literature related to it. To find such BS, Scopus (https://www.scopus.com/home.uri) a popular, multidisciplinary, peer-reviewed literature indexed in it as a data source for the bibliographic data was chosen. The search string ((TITLE-ABS-KEY("Bibliometric analy*") AND TITLE-ABS-KEY("COVID 19" OR "coronavirus" OR "SARS-CoV-2")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (PUBYEAR,2020))) was used to look for the documents. This search strategy facilitated in identifying the documents consisting of these terms in the title, abstracts, or keywords (both author and indexed keywords). The search was performed on 11th January 2021 and records indexed up to this date were included in the study. The restriction of time span, document type, and languages was put for the study. This search leads to the identification of 49 documents. Scopus database allows downloading the bibliographic data in various formats, in this work it was downloaded in the CSV file format. The abstracts of these documents were read and the documents discussing BS related to COVID-19 were selected for the study. This filtering resulted in a set of 40 documents and the full texts of these documents were downloaded for the next phase of the study.

4.2. Phase Two: Review of Bibliometric Studies

The second phase of the study deals with the parametric review of BS based on various parameters. These parameters were extracted by studying the various highly cited bibliometric analysis performed in the literature related to COVID-19.

These parameters were then divided into two categories namely; general parameters and granular parameters. The general parameters like database used, software used, time span of the study, etc provide a basic review of the BS on COVID19. The granular parameters basically focused on core findings of the BS on COVID-19, like the number of documents in the study, major document types, most productive authors, organizations, etc. Once these were summarized, a detailed discussion was done on the acquired information for proper interpretation of the studies.

5. Results and Discussion

Here, the details of the acquired publications of BS on COVID-19 have been provided. To provide the details of the literature acquisition part, the quantitative details of the publication have been discussed, whereas for the review of BS the qualitative details of the study based on parameters are elucidated.

5.1. Literature Acquisition

The study investigated the presence of scientific outputs on a pinpointed topic. Thus the search strategy as mentioned in the methodology section yielded 48 documents however when the abstracts of these documents were read, one document was deemed unfit for the study and the rest of 39 documents were kept in the study. The quantitative characteristics of these documents have been discussed here. The dominating document type was article type with 35 documents in the study; the rest of the documents were review, letter, and short communications. All of the 39 documents had journals as their source type and were published in the year 2020. Only four papers had a single author and the remaining papers were written in collaboration. A

total of 163 authors were involved in 39 publications and only two authors S. Gochhait; S. Ram had two publications each. A total of 109 organizations are credited for these 40 documents, and very few of them, like Universidad de Granada(Spain), Symbiosis International deemed University(India) were credited with multiple publications (3 publications). A total of 30 countries were credited for these publications and the top contributors were India (12 publications), China (6 publications), Spain (5 publications). The most used keywords are COVID-19 (30 times), bibliometric analysis (24 times), bibliometrics (19 times), coronavirus (22 times). According to the source titles, the dominating subject areas were found to be Social Sciences, Medicine, and Environmental Sciences. These facts mentioned above clearly indicate that the BS on COVID-19 came thick and fast in this pandemic to provide a holistic view of the research being carried out in the domain on COVID-19.

5.2. Review of Bibliometric Studies

This section basically deals with the parametric review of BS on COVID-19. For extracting the parameters of this study, existing literature on bibliometric analysis related to COVID-19 that received maximum citations according to the Scopus database were selected Lou et al.[23](43 citations); Verma and Gustafsson[24](24 citations); Kambhampati et al.[25](17 citations), Dehghanbanadaki et al.[26](13 citations). The referred works had tried to assess the trend of scientific publications and provided a detailed view of the research progress in COVID-19 related research. While extracting the parameters of the study it was kept in mind that the parameters should be standard ones so that the research communities can make use of these parameters to review the existing BS performed in other disciplines like library and information science, mathematics, etc. To perform the study, two sets of parameters were defined namely general and granular; these parameters and the parametric review of selected BS on COVID 19 have been discussed below:

5.3. General Parameters

The general parameters are the parameters that describe the basic details of a BS that has been performed. These basic details provide an overview of the studies. These parameters include; data source, search string, data format, purpose of study, timespan, publication year, publication source, received citation, tools employed, publication name. Each of these has been briefly discussed below and then values for each of these parameters that were extracted from the BS and has been represented in table 1:

5.3.1. Publication Year

It refers to the year in which the BS has been published. The parameter allows identifying the rate at which BS has been published and how current or obsolete the studies are. For the purpose of this research, the publication year was restricted to 2020 as this is the year COVID-19 related articles are published the most but for other disciplines, the restriction used here can be removed.

5.3.2. Publication Source

It refers to the source in which the BS has been published. The parameter allows in identifying the journal, conference, etc that have published these studies. It also gives an idea about the quality of the published article and the subject area of the source.

5.3.3. Purpose of Study

It refers to the purpose of the BS. The parameter allows in pinpointing the objective of the work that drives BS. For example, Raju and Patil's study [27] aimed to analyze Indian Publications on SARS-CoV-2, whereas Viedma et al.[28], conducted a bibliometric analysis of the coronavirus research from the global front based on the available literature, keeping COVID-19 as a focused area.

5.4. Data Source

It refers to the database(s) used to obtain the bibliographic data used in performing the specific BS. Though there are various databases available for the scientific community thus this parameter allows defining the scope and exhaustiveness of the study. Some studies may use more than one database for obtaining the data for example, Raju and Patil[27] used the WHO COVID-19 database; Belli et al.[29] used (a)Web of Science platform which included KCI-Korean Journal Database, Russian Science Citation Index and SciELO Citation Index and (b) Web of Science Core Collection which included Science Citation Index-Expanded, Social Science Citation Index, Arts & Humanities Citation Index databases.

5.4.1. Search String

It refers to the combination of keywords used to obtain the records of the documents used in performing the specific BS. The search string for different studies can be different and it directly affects the number of records that are obtained. Even the search string in the same database can also be different, resulting in different numbers of results. Search strings are generally represent

tative of the purpose of the study. For example, Viedma et al.[28] used the following search string in the WOS database TS=("Wuhan coronavirus" OR "Wuhan seafood market pneumonia virus" OR "Covid19*" OR "Covid-19*" OR "Covid-2019*" OR "coronavirus disease 2019" OR "SARS-CoV-2" OR "sars2" OR "2019-nCoV" OR "2019 novel coronavirus" OR "severe acute respiratory syndrome coronavirus 2" OR "2019 novel coronavirus infection" OR "coronavirus disease 2019" OR "coronavirus disease-19" OR "novel coronavirus" OR "coronavirus" OR "SARS-CoV-2019" OR "SARS-CoV-19") ; whereas Belli et al.[29] used the following search string in WOS database (TS: "CORONAVIRUS OR COVID-19 OR SARSCOV-2 OR 2019-nCoV") and Hamidah et al.[30] TITLE-ABS-KEY ("Covid-19") in the Scopus database.

5.4.2. Data Format

It refers to the format in which bibliographic data was obtained to perform the study. There exist various data formats in the literature. A well-accepted or reusable data format allows checking the data's genuineness and helps to conform to the research data management practices. Various databases provide data in various formats like CSV data format, tab-delimited, text file format, and reference management software like MENDELEY, RIS format for Endnote, etc.

5.4.3. Time-span refers to the time period for which the bibliographic data was obtained to perform the study. The time period of the study also directly affects the number of records obtained for the study. It is expected that the greater the time span, the more the number of records but it may happen by application of various exclusion criteria the number of records may be reduced. Time-span is also related to the BS exhaustive, scope, and currency of the literature studied for the analysis. For example, Viedma et al.[28] restricted the time span as 1970 - 2020 i.e., 50 years, whereas Raju and Patil[27] restricted the time span from 2/3/2020 to 12/5/2020 i.e. just 70 days.

5.4.4. Tools Employed

It refers to the software used for processing bibliographic data to perform the BS. A number of bibliometric tools are available in the literature with various features that can be used for the BS. The choice of the tool to be used in a study solely depends on the researcher and the objective of the research. A number of studies employ one or more than one tool to analyze the bibliographic data. For example, El Mohadab et al.[31] used VOSviewer and Wordle; whereas Zhai et al.[32] used Citespace. 5.6.R2, VOSviewer1.6.12, and Excel 2016.

5.4.5. Citations Received

It refers to the number of citations received by the BS from the time it was published. It basically tells about the visibility, use, and impact of the BS.

5.5. Granular Parameters

The granular parameters are the parameters that describe the BS in detail that have been performed. These granular parameters describe the core findings of the studies that have been used to draw conclusions. These parameters include; number of documents, document type, most productive authors, most productive organization, most productive countries, most productive sources, most productive funding agencies, most used keywords, top cited articles, and collaboration network. Again each of these has been briefly discussed below and then values for each of these parameters that were extracted from the BS have been represented in table 2.

5.5.1. Number of Documents

It basically refers to the number of documents on which the particular BS was performed after using the various exclusions or filter criteria. It basically tells about the exhaustiveness of the study. The number of documents can undoubtedly vary based on the search string used, time-span, purpose, or even the database used for the BS.

5.5.2. Major Document Type

It refers to the most preferred document type according to the BS. The document types can be articles, reviews, letters, etc. This parameter can also be used as a filter for the BS to reduce the number of documents in a study.

5.5.3. Most Productive Subject Area

It refers to the most productive subject area according to the BS in terms of the number of documents published in that particular subject area according to the study. This parameter allows identifying the numerous contributions made in a subject area that depicts the extensive work of the field.

5.6.1. Most Productive Authors

It refers to the most productive authors according to the BS in terms of the number of documents published by a particular author in the field. This parameter allows identifying the multiple contributions made by authors that depict their extensive work and deeming them as pioneers of the field.

5.6.2. Most Productive Organization

It refers to the most productive organization according to the BS in terms of the number of documents published by a particular organization in the field. This parameter allows identifying the multiple contributions made by an organization that depicts the extensive work in the field by the various organizations and deeming them as pioneers of the field.

5.6.3. Most Productive Countries

It refers to the most productive countries according to the BS in terms of the number of documents published by a particular country in the field. This parameter allows identifying the multiple contributions made by a country that depicts the extensive work in the field by the various countries and deeming them as pioneers of the field.

5.6.4. Most Productive Sources

It refers to the most productive sources according to the BS in terms of the number of documents published by a particular source in the field. This parameter allows identifying the multiple contributions made by a source that depicts the extensive work in the field by the various sources and deeming them as core sources for such kinds of studies.

5.6.5. Most Used Keywords

It refers to the most occurred keywords in the documents that were used in the BS. It reveals the trend of research of the document corpus and clustering of these keywords may also help categorize the document corpus into various categories.

5.6.6. Top Cited Articles

It refers to the most cited article according to the BS. This parameter helps to identify the core literature which is being referred to by the scientific community as a reference point for the research in the domain.

5.6.7. Collaboration Network

Scientific collaborations are an integral part of research in any field. The collaboration networks are used to depict how authors/ countries/organizations/keywords/cocitations/citations/bibliographic coupling are related to each other in the field of scientific research. It basically reveals the hidden patterns of research. Thus the analysis of these is integral to BS. The collaboration network may vary according to the study's objective and the capability of the tool that is being used.

Publication	PY	PS	Purpose	DS	SS	TS	DF	SU	CR
Lou et al.[23]	2020	European Review for Medical and Pharmacological Sciences	To analyze the publications about COVID-19 to summarize the research hotspots and make a review, to provide a reference for researchers in the world.	PubMed	(((((((((pneumonia) OR 2019-nCoV) OR COVID-19) OR Corona Virus Disease 2019) OR Novel Coronavirus Pneumonia) OR NCP) OR 2019 novel coronavirus) OR SARS-CoV-2) OR 2019 Novel Coronavirus Diseases OR novel coronavirus) AND Wuhan	From inception to March 1, 2020	NA	Excel	43
Verma &	2020	Journal of Business Research	Study of COVID-19 literature in the business and management domain to identify current areas of research and propose a way forward.	SCOPUS and WOS	"2019-nCoV" OR "COVID-19" OR "Coronavirus Disease 2019" OR "Novel Coronavirus Pneumonia" OR "NCP" OR "2019novel coronavirus" OR "SARS-CoV-2" OR "2019 Novel CoronavirusDiseases" OR "novel coronavirus" OR "pneumonia."	01/01/2020 until 11/05/2020	NA	BibExcel and VOSviewer	24
Kambhampati et	2020	Journal of Clinical Orthopaedics and Trauma	To study the growth of COVID-19 research publications after the outbreak.	PubMed	(SARS-Cov-2) OR (COVID-19 AND (2019:2020[pdat]))	From 2019 to 25/04/2020	NA	NA	17

Dehghanbanadaki et al.[26]	2020	Medical Journal of the Islamic Republic of Iran (MJIRI)	To gain a better understanding of the scientific literature on COVID-19.	SCOPUS	(sars2) OR (sars-2) OR ("SARS 2") OR ("novel corona virus pneumonia") OR ("new human coronavirus") OR ("2019 novel coronavirus") OR ("2019 novel coronavirus infection") OR ("novel coronavirus") OR ("new coronavirus") OR ("severe acute respiratory syndrome coronavirus 2") OR ("sudden acute respiratory syndrome coronavirus 2") OR ("China coronavirus") OR("Wuhan coronavirus") OR ("Wuhan seafood market pneumonia virus") OR (covid-19) OR ("COVID19 virus") OR ("Coronavirus disease 2019") OR TITLE-ABS ("coronavirus disease-19") OR ("Coronavirus disease 2019 virus") OR ("SARS-CoV-2") OR ("2019-nCoV") OR ("2019-nCoV disease") OR ("2019-nCoV infection")	From 1st December to 1st April 2020	NA	Excel, GunnMap 2, VOSviewer	13
Vasantha Raju and Patil[27]	2020	Medrxiv (preprint)	To study the status of Indian publications in COVID-19.	WHO COVID-19 database	"COVID-19" and "India"	From 2nd March 2020 to 12th May 2020	CSV	Excel	1
Viedma et al.[28]	2020	El profesional de la información	To provide a complete conceptual analysis of the main coronavirus types and strains in the literature.	WOS	TS=("Wuhan coronavirus" OR "Wuhan seafood market pneumonia virus" OR "Covid19*" OR "Covid-19*" OR "Covid-2019*" OR "coronavirus disease 2019" OR "SARS-CoV-2" OR "sars2" OR "2019-nCoV" OR "2019 novel coronavirus" OR "severe acute respiratory syndrome coronavirus 2" OR "2019 novel coronavirus infection" OR "coronavirus disease 2019" OR "coronavirus disease-19" OR "novel coronavirus" OR "coronavirus" OR "SARS-CoV-2019" OR "SARS-CoV-19"	From 1970 to 2020	NA	SciMAT	7
Belli et al.[29]	2020	Scientometrics	To identify the most productive countries in coronavirus publications, to analyze the international scientific collaboration on this topic, and to study the proportion and typology of open accessibility to these publications.	WOSCC	Topic Search:"CORONAVIRUS OR COVID-19 OR SARS-COV-2 OR 2019-nCoV"	From 2001 to 2020	NA	VOSviewer	5
Hamidah et al.[30]	2020	Indonesian Journal of Science & Technology	To analyze the scope of COVID-19 research.	SCOPUS	"Covid-19"	Till 25th April 2020	.ris format	VOSviewer, HistCite	5
El Mohadab et al.[31]	2020	Chaos, Solitons, and Fractals	To study the exponential increase of the scientific production recorded in the various databases around the Covid-19.	SCOPUS, WOS, and PubMed	"covid- 19"and "coronavirus"	01/01/2020 until 23/05/2020	NA	VOSviewer and Wordle	3
Zhai et al.[32]	2020	International Journal of Environmental Research and Public Health	To explore the distribution of research capabilities of countries, institutions, and researchers, and the hotspots and frontiers of coronavirus research in the past two decades.	WOSCC	TS = (coronavirus or Middle-East-Respiratory-Syndrome or Severe-Acute-Respiratory Syndrome or 2019-nCoV or COVID-19 or SARS-CoV-2)	2003 to 2020	NA	Excel, CiteSpace, and VOSviewer.	11

Nowakowska et al.[33]	2020	Biomedicine & Pharmacotherapy	To study the peer-reviewed and preprint papers published in the English language on issues related to COVID-19 within the first three months of the outbreak.	PubMed/MEDLINE and SCOPUS	'SARS-CoV-2', '2019-nCoV', and 'COVID-19'	First three month	NA	NA	8
Jia et al.[34]	2020	Medicine	To study the overview of coronavirus and hot topics.	WOSCC	Collected from WOSCC using index keyword "coronavirus"	From 2003 to 11/02/2020	Plain Text	CiteSpace	3
Sa'ed et al.[35]	2020	BMC Infectious Diseases	To track the current hotspots, and highlight future directions of COVID-19 research.	SCOPUS	"COVID 19" or "2019 novel coronavirus" or "coronavirus 2019" or "coronavirus disease 2019" or "2019-novel CoV" or "2019 ncov" or COVID 2019 or COVID19 or "corona virus 2019" or nCoV-2019 or nCoV2019 or "nCoV 2019" or 2019-ncov or COVID-19 or "Severe acute respiratory syndrome coronavirus 2" or "SARS-CoV-2	Till 19/06/2020	NA	Excel, VOSviewer	7
Liu et al.[36]	2020	BMC Medical Research Methodology	To study the growth of early medical literature on COVID-19	PubMed and EMBASE	"COVID" or "coronavirus"	From 1st January 2020 to 24 March 2020	NA	Excel, Python	8
Zhou et al.[37]	2020	International Journal of Environmental Research and Public Health	This study aims to investigate the global research routine and trends of coronavirus over the last twenty years based on the production, hotspots, and frontiers of published articles as well as to provide the global health system with a bibliometric reference.	WOSCC(SCIE)	Search keywords as follows: (TS = (coronavirus* OR corona virus)) AND LANGUAGE: (English) AND DOCUMENT TYPES: Article).	1 January 2000 to 17 March 2020	NA	EndNote, SPSS, CiteSpace, VOSviewer	7
Ram [38]	2020	Science & Technology Libraries	This study attempts to trace the trends of research associated with "Coronavirus" for a period of 50 years using the SCOPUS database.	SCOPUS	Using the keywords Coronavirus, beta coronavirus, novel coronavirus, nCoV, coronavirus disease, covid, covid19, SARS-CoV, and MERS-CoV	From 1970 to 2019	NA	VOSviewer	7
Odone et al.[39]	2020	Acta Biomed	To reflect on content, trends, and quality of scientific publishing onCOVID-19	MEDLINE, WOS	COVID-19	From 31st December to 7th May 2020	NA	NA	5
Joshua and Sivaprakasam [40]	2020	Medical Journal of the Islamic Republic of Iran (MJIRI)	Gaining knowledge about the current literature available on Corona viruses across the globe.	WOS(SCIE)	'Coronavirus'	from January 1968 to March 2020	NA	MS-Excel, Word Cloud generator, VOSviewer, and ArcGIS	1
Casado-Aranda et al.[41]	2020	Environmental Research	The aim was to synthesize how the publications, academics are resorting to BS from the perspectives of the disciplines such as biology, medicine, socioeconomics, and tourism.	WOSCC and SCOPUS	ALL (("2019-nCoV" OR "Covid-19″ OR "COVID-19″ OR "SARS-CoV- 2″ OR "coronavirus" OR "corona virus")) AND (LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "ENER") OR LIMIT-TO (SUBJAREA, "EART")) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2020))TS = ("2019-nCoV" OR "Covid-19″ OR "COVID-19″ OR "SARS-CoV- 2″ OR "coronavirus" OR	1 December 2019 and 6 September 2020.	NA	SciMAT	5

					"corona virus") AND LANGUAGE: (English) AND TYPE: (Article OR Review) Filtred by: Web of Science Categories: Green Sustainable Science Technology OR Environmental Sciences OR Environmental Studies.				
Tanrıverdi et al.[42]	2020	Journal of Air Transport Management	This study deploys a comprehensive BS and graphical mapping of the JATM knowledge body through CiteSpace visualization	WOS	"Publication name = Journal of Air Transport Management"	2001 to 2019	NA	CiteSpace	1
Abideen et al.[43]	2020	Journal of Health Research	The goal of this paper is to systematize and identify gaps in previous research and suggest potential recommendations as a conceptual framework from a strategic point of view.	SCOPUS and WOSCC(SCIE,SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI)	The search code for Scopus database was – (TITLE (pandemic) OR TITLE (COVID-19)AND TITLE-ABS-KEY (strategy) AND TITLE-ABS-KEY (strategies)) AND PUBYEAR > 2009, WOS TOPIC: (COVID-19) OR TOPIC: (pandemic) AND TOPIC: (strategy) OR TOPIC: (strategies)	2009–2020	Manual	VOSviewer	0
Ali et al.[44]	2020	Global Business Review	The aim of this article is to examine the BS of global publication output on coronavirus	WOS ('SCIE', 'SSCI' and 'A&HCI)	'TS' = 'Coronavirus' AND 'Coronavirus Disease' AND 'COVID-19'.	2000-2019	NA	NA	0
Gautam et al.[45]	2020	International Journal of Mathematical, Engineering and Management Sciences	The study aims to analyze the work done in this field through a state-of-the-art review of articles based on COVID-19 and discuss the current trends in the epidemiology of this disease entity with special reference to India and the effects of this pandemic on the environment	SCOPUS	"COVID-19" OR "COVID19" "SARS-COV-2" "Coronavirus disease" OR "Corona virus disease" "Novel Corona Virus disease" OR "Novel Coronavirus disease"	Beginning of pandemic to April 10th, 2020	NA	VOSviewer	1
Oh and Kim[46]	2020	Science Editing	This BS investigated the current state of documents on coronavirus disease 2019 (COVID-19) published in nursing journals	WOS, (SCIE and SSCI)	(TS=COVID-19 OR 2019-nCoV OR coronavirus 2019 OR Coronavirus disease 2019 OR SARS-CoV-2) AND (SU=Nursing).	Up toUpto July 10, 2020	XLS	SPSS Statistics ver. 22.0	4
Zyoud and Zyoud [47]	2020	Environment, Development, and Sustainability	The work intends to track the current hotspots and research trends on COVID-19 in environmental fields.	SCOPUS	TITLE-ABS ("COVID 19" OR "2019 novel coronavirus" OR "coronavirus 2019" OR "coronavirus disease 2019"OR "2019-novel CoV" OR "2019 ncov" OR "COVID 2019" OR "COVID19" OR "coronavirus 2019" OR "nCoV-2019" OR "nCoV2019" OR "nCoV 2019" OR "2019-ncov" OR"COVID-19" OR "Severe acute respiratory syndrome coronavirus 2" OR "SARS-CoV-2")AND SRCTITLE ("environ*").	Up to August 8, 2020.	XLS	SPSS	1
Ram and Nisha [48]	2020	DESIDOC Journal of Library & Information Technology	This is an analysis of 806 highly cited articles was carried out based on the data retrieved from SCOPUS multidisciplinary database on 'Coronavirus' research published during 1970-2019 and 2020	SCOPUS	((TITLE-ABSKEY(" coronavirus") OR TITLE - ABSKEY("SARS Coronavirus") OR TITLE -ABS-KEY("betacoronavirus") ORTITLE -ABS-KEY("nCoV") OR TITLEABS-KEY("coronavirus disease") ORTITLE -ABS-KEY("covid") OR TITLE-ABS-KEY("covid19") OR TITLE-ABSKEY("covid-19") OR TITLE-ABSKEY("SARS-CoV") OR TITLE - ABSKEY(" MERS-CoV")) AND (EXCLUDE(PUBYEAR,2020) OR EXCLUDE (PUBYEAR,1969))	1970-2019 and till 30 March 2020	NA	VOSviewer	1

Deng et al.[49]	2020	Frontiers in Cellular and Infection Microbiology	Performs a BS along with visualization tools to analyze 15,207 publications related to human coronavirus from the SCOPUS database, using indicators on publication and citation, journal, country or territory, affiliation and international cooperation, author, and keyword co-occurrence cluster	SCOPUS	TITLE-ABS-KEY ("human coronavirus" OR "human corona virus" OR HCoV OR "novel coronavirus" OR"novel corona virus" OR nCoV OR "severe acute respiratorysyndrome" OR ({SARS} AND "_CoV" OR _virus OR crisis ORoutbreak OR epidemic OR pandemic) OR "SARSr-CoV" OR"middle east respiratory syndrome" OR ({MERS} AND "_CoV"OR _virus OR crisis OR outbreak OR epidemic OR pandemic)OR "camel flu" OR "EMC/2012" OR "coronavirus disease2019" OR "COVID-19" OR (coronavirus OR "corona virus"OR "_CoV" AND 229E OR OC43 OR NL63 OR HKU1) ORHCoV229E OR HCoVOC43 OR HCoVNL63 ORHCoVHKU1)	February 15, 2020.	CSV	GraphPad Prism 8, and VOSviewer 1.6.12	0
Fan et al.[50]	2020	Frontiers in Cellular and Infection Microbiology	Aimed to explore the differences between English language and Chinese language Medical/Scientific journals publications, particularly aiming to explore the efficacy/contents of the literature published in English and Chinese in relation to the outcomes of management and characterization of COVID-19 during the early stage of COVID-19 pandemic.	EMBASE, SCOPUS, ChineseBiomedical Database (SinoMed), China National Knowledge Infrastructure(CNKI), VIP information/ Chinese Scientific Journals database (VIP) and WANFANG	COVID-19, COVID 19, 2019-nCov, SARS-CoV-2, 2019 novel coronavirus, coronavirus disease2019 and coronavirus disease-19.	2019 to 1st March 2020	NA	VOSviewer 1.6.14, and CiteSpace V	9
Akhter[51]	2020	Library Philosophy and Practice (e-journal)	Attempts to ascertain publications output on coronavirus as reflected in Scopus database from the Chinese perspective. The most productive contributors, institutions, journals, and core subjects in coronavirus publications are identified in this study	SCOPUS	TITLE-ABS-KEY (coronavirus) AND (LIMIT-TO (AFFILCOUNTRY, "China")) AND (LIMIT-TO (PUBYEAR, 2020 to 2011))).	2011-15/02/2020	Excel	VOSviewer	0
Ramakrishnanet al.[52]	2020	Library Philosophy and Practice (e-journal)	This paper presents a BS of the literature in the field of Coronavirus in MEDLINE data which has been covered in PubMed	PubMed	'Coronavirus'	2000 to 2019		SPSS	0
Idhris et al. [53]	2020	Library Philosophy and Practice (e-journal)	Study conducted a BS of scientific output on the COVID-19 pandemic outbreak using the Web of Science (WOS)database.	WOS	TS= ("COVID-19" OR "2019 novelcoronavirus infection" OR " COVID19" OR "coronavirus disease 2019" OR "coronavirusdisease-19" OR "2019-nCoV disease" OR "2019 novel coronavirus disease" OR "2019-nCoVinfection" OR "COVID19 virus" OR "COVID-19 virus" OR "coronavirus disease 2019 virus"OR "SARS-CoV-2" OR "2019-nCoV" OR "2019 novel coronavirus").	1 January , 2019 to 24 June, 2020	Text file	R studio (biblioshiny) software.	0
Huded and Balutagi[43]	2020	Library Philosophy and Practice (e-journal)	Study is performed to understand the research characteristics such as highly prolific authors, country-wise contribution, highly productive journals, research institutions, international collaboration, and citation habits.	SCOPUS, JCR, Altmetric	"COVID-19"	Till 26th April 2020	NA	VOSviewer	0
Iskandar et al.[55]	2020	Library Philosophy and Practice (e-journal)	Study discusses the co-authorship of COVID-19 research covering author productivity and author	WOS	TOPIC: ("covid") AND YEAR PUBLISHED: (2020)	11th May 2020	NA	VOSviewer	0

			collaboration.						
Hugar et al.[56]	2020	Library Philosophy and Practice (e-journal)	The study evaluated contemporary scientific literature to assess the literature available on COVID-19, and identify the leading research patrons globally.	SCOPUS	"COVID-19"	2001 to 2020	NA	MS-Excel	0
Klingelhöfer et al [57]	2020	Journal of global health	The study provides background information of research on coronaviruses (CoV) as a basis for the scientific situation of the global pandemic COVID-19 and a source for a better understanding of research patterns from the times before COVID-19.	WOS	"*corona virus" OR "*coronavirus" OR "SARS" OR "MERS" OR "CoVID-19" OR "severe acute respiratory syndrome" OR "Middle Eastrespiratory syndrome"	18/03/2020	NA	VOSviewer	0
Warin [58]	2020	Journal of Medical Internet Research	The goal is to simplify the workflow of interested researchers, with multidisciplinary research in mind.	PubMed	("COVID-19" OR Coronavirus OR "Corona virus" OR "2019-nCoV" OR "SARS-CoV" OR "MERS-CoV" OR "Severe Acute Respiratory Syndrome" OR "Middle East Respiratory Syndrome")	June 26, 2020	NA	R	0
Aristovnik et al.[59]	2020	Preprints	The main aim of this paper is to fill the gap in the literature and provide an extensive BS of COVID-19 research across the science and social science research landscape.	SCOPUS	keywords: "novel coronavirus 2019", "coronavirus 2019", "COVID2019", "COVID19", "COVID 19", "COVID-19", "SARS-CoV-2", "HCoV-19", "2019-nCoV" and "severe acute respiratory syndrome coronavirus 2"	June 1, 2020	NA	VOSviewer	3
Ng [60]	2020	BMC ComplementaryMedicine and Therapies	This study presents a BS of global research trends at the intersection of TICAM and COVID-19.	SCOPUS, MEDLINE, EMBASE, AMED, and PSYCINFO	TICAM and COVID-19	July 5, 2020,	NA	NA	0
Andersen et al.[61]	2020	BMC Medical Informatics and Decision Making	Keyword co-occurrence analysis, which provides an empirically grounded classification of concepts or taxonomy of research on COVID-19; presenting the intellectual content and structure visually.	PubMed, SCOPUS	"COVID-19", "SARS-CoV-2", "severe acute respiratory syndrome coronavirus 2", "2019-nCoV" and "2019novel coronavirus"	From 2020 and onwards	NA	VOSviewer	1

Table 1. General Parameters

Abbreviation used: Publication Year: PY, Publication Source: PS, Data Source: DS, Search String: SS, Time-Span: TS, Data Format: DF, Software Used: SU, Citation Received: CR, Statistical Package for the Social Sciences: SPSS, Science Mapping Analysis Software Tools: SciMAT, Web of Science: WOS, Web of Science Core Collection: WOSCC, Science Citation Index

Expanded: SCIE, Social Sciences Citation Index: SSCI, Arts and Humanities Citation Index: A&HCI, Conference Proceedings Citation Index-Science: CPCI-S, CPCI-SSH: Conference Proceedings Citation Index Social Science & Humanities, BKCI-S: Book Citation Index-Science, BKCI-SSH: Book citation index. Social Sciences & Humanities, ESCI: Emerging Source Citation Index

Publication Name	*Number of Documents*	*Major Document Type*	*Most Productive Subject Area*	*Most Productive Authors*	*Most Productive Organization*	*Most Productive Countries*	*Most Productive Sources*	*Most Used Keywords*	*Top Cited Articles*	*Collaboration Network*
Lou et al.[23]	183	Articles(60)	Epidemiology (68)	NA	Tongji Hospital (8)	China (123)	Journal of Medical Virology (25)	NA	NA	NA
Verma & Gustafsson [24]	256	Articles	Business and management	NA	NA	NA	NA	Covid-19, decision making, machine learning technology	NA	Co-word analysis
Kambhampati et al.[25]	6831	Review articles	NA	NA	NA	China(438)	British Medical Journal (252)	NA	NA	NA
Dehghanbanadaki et al.[26]	923	Articles (418)	NA	NA	The University of Hong Kong (30)	China (348)	BMJ Clinical Research Ed (74)	COVID-19(139), Coronavirus (117), SARS-CoV-2 (100)	Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020 Feb 15;395(10223):497-506.	Countries, keywords, sources
Vasantha Raju and Patil [27]	89	Articles (38)	Epidemiology (75)	Gupta, Nivedita (6)	AIIMS (8)	NA	Indian Journal of Medical Research (14)		Singh AK, Singh A, Shaikh A, Singh R, Misra A. Chloroquine and hydroxychloroquine in the treatment of COVID-19 with or without diabetes: A systematic search and a narrative review with a special reference to India and other developing countries. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020 May 1;14(3):241-6.(28 citations)	NA
Viedma et al.[28]	12,571	NA	Virology (4,089)	Yuen Kwok-yung	University of Hong Kong(487)	USA (4,513)	Journal of Virology (1,134)	NA	NA	NA
Belli et al.[29]	19435	Articles (18875)	NA	NA	University of Hong Kong(456)	USA (3431)	NA	NA	NA	Country and organization
Hamidah et al.[30]	3,513	NA	NA	NA	NA	China	NA	Coronavirus	NA	Keyword visualization
El Mohadab et al.[31]	5161(WOS)+10228 (SCOPUS)+7991(PubMed)	Articles (both)	Medicine (SCOPUS) astronomy and astrophysics (WOS)	Caracciolo, G (SCOPUS) Wang, J (WOS)	Chinese Academy of Sciences(both)	China (both)	NA	Coronavirus, sar-cov-2, covid-19	NA	Author, country, Organisation, Keywords
Zhai et al.[32]	11036	Articles (9459)	Virology (2957)	Yuen, Kwok-yung (214)	University of Hong Kong (595)	USA (3606)	Journal of Virology(826)	Severe Acute Respiratory Syndrome (4451)	NA	authors, organizations, countries, and journals
Nowakowska et al.[33]	2062	Articles	Molecular biology and	NA	NA	NA	NA	SAR-COV-2, COVID-19	NA	NA

			pathogenicity							
Jia et al.[34]	8433	Only article	Virology(263)	Yuen Kwok-yung	University of Hong Kong (399)	USA (2791)	NA	SARS-CoV (1781), infection (1528), acute respiratory syndrome (1213)	Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W, Rollin PE. A novel coronavirus associated with severe acute respiratory syndrome. New England journal of medicine. 2003 May 15;348(20):1953-66 (1021 citations)	Co-author, Co-occurrence, and Co-citation
Sa'ed et al.[35]	19044	Articles	Fever, cough, severe patients	NA	Huazhong University of Science and Technology (422)	USA (4479)	British Medical Journal (522)	COVID-19	NA	Co-occurrence of words
Liu et al.[36]	1703	Articles	Emergency and Prehospital Care	NA	NA	China (323)	NA	NA	NA	Evidence map of topics
Zhou et al.[37]	9043	article	NA	NA	University of Hong Kong(434)	USA (3101)	Journal of Virology(883)	"coronavirus", "MERS-CoV", "SARS", and "SARS-CoV"	Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W, Rollin PE. A novel coronavirus associated with severe acute respiratory syndrome. New England journal of medicine. 2003 May 15;348(20):1953-66(1839 citations)	Country collaboration
Ram[38]	18,003	Article (13,393)	NA	Enjuanes, L.(182)	The University of Hong Kong (511)	USA (5646)	Journal of Virology (1128)	CoV (9065), SARS (7859), Severe Acute Respiratory Syndrome (7433)	Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W, Rollin PE. A novel coronavirus associated with severe acute respiratory syndrome. New England journal of medicine. 2003 May 15;348(20):1953-66.(1839 citations)	Keywords network
Odone et al.[39]	10,000	NA	Speciality (2200)	NA	NA	USA (2647)	BMJ(337)	NA	NA	NA
Joshua and Sivaprakasam[40]	6424	Articles (5787)	Infectious diseases (5341)	NA	The University of Hong Kong (506)	NA	Journal of Virology (810)	Coronavirus, Pneumonia, 2019-nCoV	Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W, Rollin PE. A novel coronavirus associated with severe acute respiratory syndrome. New England journal of medicine. 2003 May 15;348(20):1953-66	Author
Casado-Aranda et al.[41]	440 (Scopus &WoS)	Article (440)	NA	Wang, Yangjun (7)	China CDC Key Laboratory of Environment and Population Health	China	Science of the Total Environment (116)	COVID-19 and the environment	NA	co-word analysis
Tanrıverdi et al.[42]	1483	Article ()1401	NA	Niemeier HM (22)	Vrije Universiteit Amsterdam	USA	Transportation science technology	Airport	Liou JJ, Tzeng GH, Chang HC. Airline safety measurement using a hybrid model. Journal of air transport management. 2007 Jul 1;13(4):243-9.(244)	Co-citation Analysis, Co-author Analysis, Co-word Analysis, Burst detection analysis, Cluster

										Analysis
Abideen et al.[43]	927	Article	NA	NA	NA	Na	The British Medical Journal	Disease Control	NA	co-author citation burst, keywords co-occurrence
Ali et al.[44]	10,861	Article	Virology	Yuen Kwok-yung	University of Hong Kong	USA	Journal of Virology	NA	NA	NA
Gautam et al.[45]	581	Article	NA	Mahase, E	NA	China	BMJ Clinical Research Ed	NA	Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020 Feb 15;395(10223):497-506.	authors, co-authors, and institute network visualization
Oh and Kim[46]	132	Article	Nurse training	NA	The University of Technology Sydney	USA	Journal of Clinical Nursing	NA	NA	NA
Zyoud and Zyoud[47]	729	Article	NA	Dewit te, J.D	Chinese Academy of Sciences	China	International Journal of Environmental Research and Public Health	air quality	Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, Ho RC. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. International journal of environmental research and public health. 2020 Jan;17(5):1729.	co-occurrence
Ram and Nisha[48]	806	Article	NA	Kwok Yung	University of Hong Kong	USA	Journal of Virology	NA	NA	Co-citation network
Deng et al.[49]	15,207	Article	NA	Yuen Kwok-yung	University of Hong Kong	USA	New England Journal of Medicine	SARS	Jones KE, Patel NG, Levy MA, Storeygard A, Balk D, Gittleman JL, Daszak P. Global trends in emerging infectious diseases. Nature. 2008 Feb;451(7181):990-3.	Keywords co-occurrence
Fan et al.[50]	864	NA	NA	Li Y (Wuhan University)	Wuhan University, Hubei	China	Journal Medical, Virology	SARSCoV-2	NA	Different authors, countries/ provinces, and institutions. keywords co-occurrence
Akhter [51]	1331	Article	Immunology and Microbiology	Jiang, S.	Chinese Academy of Agricultural Sciences, Beijing	USA	Journal of Virology	non-human	Woo PC, Lau SK, Lam CS, Lau CC, Tsang AK, Lau JH, Bai R, Teng JL, Tsang CC, Wang M, Zheng BJ. Discovery of seven novel Mammalian and avian coronaviruses in the genus deltacoronavirus supports bat coronaviruses as the gene source of alphacoronavirus and betacoronavirus and avian coronaviruses as the gene source of gammacoronavirus and deltacoronavirus. Journal of virology. 2012 Apr 1;86(7):3995-4008.	authors, countries and occurrence of keyword
Ramakrishnan et al.[52]	10700	Research Support	NA	NA	NA	USA	Emerging Infectious Diseases	NA	NA	NA

Idhris et al. [53]	10850	Articles	NA	Wang Y	Huazhong University of Science and Technology	USA	British Medical Journal (BMJ)	covid-19	Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020 Feb 15;395(10223):497-506.	NA
Huded and Balutagi [54]	3693	Articles	Medicine	Mahase, E.	Huazhong University of Science and Technology	China	BMJ Clinical Research Ed	covid-19	Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. The lancet. 2020 Feb 15;395(10223):497-506.	NA
Iskandar et al.[55]	2954	Early access	NA	NA	NA	USA	NA	NA	NA	Country, author
Hugar et al.[56]	541	Articles	Medicine	Akashi, M	Utrecht University, Netherlands	USA	PLOS One	NA	NA	NA
Klingelhöfer et al. [57]	6905	NA	virology	NA	University Hong Kong, China	USA	NA	coronavirus	Ksiazek TG, Erdman D, Goldsmith CS, Zaki SR, Peret T, Emery S, Tong S, Urbani C, Comer JA, Lim W, Rollin PE. A novel coronavirus associated with severe acute respiratory syndrome. New England journal of medicine. 2003 May 15;348(20):1953-66.	Country, keywords
Warin [58]	3400	Articles	epidemiology	Li Y	NA	China	NA	COVID-19	NA	Country, author,
Aristovnik et al.[59]	10344	Articles	Infectious diseases	NA	NA	NA	Journal of Medical virology	COVID-19	NA	keyword
Ng[60]	296	Articles	Traditional Chinese medicine	NA	NA	China	Chinese Traditional and Herbal Drugs	NA	Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JL, Bhattoa HP. Evidence that vitamin D supplementation could reduce risk of influenza and COVID-19 infections and deaths. Nutrients. 2020 Apr;12(4):988.	NA
Andersen et al.[61]	411	NA	NA	NA	NA	NA	NA	Corona virus infection	NA	Keywords, research paper

Abbreviation used: *Not Applicable: NA, Web of Science: WOS.*

Table 2. Granular parameters

9. Discussion

Data obtained about the BS according to the general parameters revealed intriguing and important facts. All the studies were published in the year 2020 which implies that as soon as the pandemic started, the research community understood the importance of the topic and started presenting the data about the literature of COVID-19 from different aspects. The idea of bibliometrics has originated from the discipline of Library and Information Science (LIS) so it's obvious that this BS will be published in sources related to LIS. This has been proved here as data is obtained from a total of 10 publications from LIS journals: *Library Philosophy and Practice*(six publications*), Scientometrics (*one publication), *DESIDOC Journal of Library & Information Technology* (one publication)*, Science & Technology Libraries* (one publication), El *profesional de la información* (one publication). Although most of the publications belonged to the discipline of Medical Sciences, i.e., 14 publications, it was scattered among them. Onlythe *Medical Journal of the Islamic Republic of Iran and Frontiers in Cellular and Infection Microbiology* had two publications each. The researchers of various other disciplines like Business, Environmental Sciences also approached these BS. *The International Journal of Environmental Research and Public Health had two publications.*

*E*ven a few of the business-related journals like *Global Business Review and Journal of Business Research* also published a BS. The purpose of the study is that it acts as a compass for the work and defines the study's scope. The tables suggest that the purpose of BS revolved along the lines of 'increase of literature on COVID-19 or Coronavirus, identification of most productive countries, organizations, authors, and most cited articles in coronavirus publications, to analyze the collaboration network nationally and internationally on this topic. The study also tried to identify the hot topics for coronavirus research like - when the pandemic started, there was more emphasis on vaccination or identifying the various strains for COVID-19. This was basically based on the keyword co-occurrence cluster. Keyword co-occurrence analysis was perceived as the empirical grounded for classification of concepts or taxonomy of research on COVID-19. Few studies like Zyoud and Zyoud[48] aimed to track the hotspots and research trends on COVID-19 in environmental fields and studied the literature from a different point of view whereas Tanrýverdi et al.[41] the study was aimed at a BS of the articles in the *Journal of Air Transport Management* from 2001 to 2019 to get the learnings out of this literature and use it for post-COVID-19 for the aviation industry. There were few studies that aimed at studying the publications of COVID-19 for a country for example Raju and Patil[27] restricted the purpose for the study to Indian publications in COVID-19. Whereas a few studies like Oh and Kim[47] restricted the purpose of the study on the documents of coronavirus disease 2019 (COVID-19) published only in one domain-specific journal like in nursing. Since the purpose of BS was sometimes very specific, the number of articles may vary a lot but the three other major factors that affect the BS are namely; the number of databases chosen, search strings, and the time-span the study was restricted to. The obtained data suggest that around 20 BS choose SCOPUS, 15 BS choose WOS, 10 BS choose PubMed/MEDLINE, and 3 BS choose EMBASE as their preferred choice of database. However, it's not the case that a BS will always choose a single database for their study. They sometimes chose more than one database like SCOPUS, WOS together[24] or WOS and PubMed/MEDLINE[39] together or PubMed and SCOPUS[61] or SCOPUS, WOS, PubMed all together[31] OR PubMed and EMBASE together[36], etc. Some of the studies like Raju and Patil[27] used the WHO COVID-19 database, whereas Fan et al.[50] used the Chinese Biomedical Database (SinoMed), China National Knowledge Infrastructure (CNKI), VIP information/Chinese Scientific Journals database (VIP), WANFANG databases which were all medical databases along with EMBASE, SCOPUS. The use of a variety of databases increases the exhaustiveness of the study and makes them more complete. Besides, the data also suggested that while using WOS as a database for the BS , the number of indexes varied, for instance, Abideen et al.[43] used SCIE, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, whereas Zhou et al.[37] used SCIE and Oh and Kim[46] used SCIE and SSCI. This directly impacts the number of records included in the studies and again contributes to the completeness or lack of the studies. As there were a variety of databases, these terms/keywords were searched through the search strings which became an important aspect for identifying the number of records for BS. Studies like Deng et al.[49], Ram and Nisha[48], Casado-Aranda et al.[41], etc. provided the complete search strings whereas few studies like Odone et al.[39], Hamidah et al.[30], Jia et al.[34] only provided the terms used for the search. A complete search string allows to have a better understanding of what are the terms with synonyms along with Boolean operations that were used for BS, in which part of document records these terms were searched like title, abstracts, or keywords or all of them, and the time–span that was considered for the study. Since in the coronavirus research, many publications started to happen during the early pandemic from December 2019, hence a lot of studies like El Mohadab et al.[31], Verma & Gustafson[24], Nowakowska et al.[33], restricted their scope for the first few months of the pandemic i.e. for four to five months. But studies like Belli et al.[29], Ram[38], and Viedma et al.[28] wanted to perform a comprehensive BS on COVID, thus kept the time-span ranging from 20 years to 50 years. Thus, though all these studies were bibliometric assessments, these factors varied a lot in the nature of the findings they obtained. It was observed that around 30 BS did not mention the format in which data were collected. Though the software used for the study gave an idea about the data format, it was not mentioned explicitly. Among those who mentioned the data format, CSV, XLS, txt formats were the dominant ones. Data processing, analysis, and visualization are important aspects of BS and there are numerous software that are available but it boils down to the user-friendliness of the software and easy interpretation of the data through the software used so that researchers can explain their data. Thus, the data suggest that 9 BS used MS-Excel, 4 BS used SPSS, 2 BS used R, 2 BS used SciMAT, 1 BS used Python, 1 BS used HistCite, and 1 used GraphPad Prism 8 as their software for data processing and analysis. Most of these tools are themselves capable of creating network visualization for authors, organizations, words, citations, etc and some of these BS were used for them also. But most of these studies for creating visualization networks use specialized software that are developed for this purpose only. Out of 39 BS, 21 of them used VOSviewer and 5 BS used CiteSpace. For generating word clouds, 1 BS used Wordle and 1 BS used Word Cloud Generators. Similarly, 1 BS used ArcGIS and 1 BS used GunnMap 2 for creating geographical maps. It was also seen that some of the studies like Zhou et al[37] used four different software viz EndNote, SPSS, CiteSpace, and VOSviewer and similarly Joshua and Sivaprakasam[40] used MS-Excel, Word Cloud Generator, VOSviewer, and ArcGIS for performing the analysis and visualization for the bibliometric assessment. Though both of them were BS, the same software was

used except VOSviewer, thus showing the variety of options available for BS. Citations are a traditional bibliometric indicator which tells about the visibility and usability of the papers that have been published. Here the citation count of the publications was taken from the SCOPUS database and among the 39 BS considered for the study only 12 of them did not receive any citations, rest 27 publications received citations. Few papers like Lou et al.[23] (43 citations); Verma and Gustafsson[24] (24 citations); Kambhampati et al.[25] (17 citations), Dehghanbanadaki et al.[26] (13 citations), Zhai et al.[32] (11 citations) received a lot of citations within a year of publication considering all these publications came in the year 2020. This clearly suggests that these BS have been extensively used for research purposes and have added a lot of value to coronavirus research.

The granular parameters of BS draw up research exhaustively as compared to the general parameter study is concerned. With the help of granular metadata, we have analyzed the BS of COVID-19 research papers elaborately. The number of research papers published since the deadly virus's origin depicts the study's attention in COVID-19 research. The number of research articles varies from 89 in Raju and Patil[27] to 23380 in El Mohadab et al.[31]. The number of research articles' variation is due to the coverage of databases, the research scope, and the study's time. Raju andPatil[27] only covers the WHO COVID-19 database, and the scope is only for India. The time considered for this study is from March 2020 to 12th May 2020. In the case of El Mohadab et al.[31], the databases included are Scopus, WOS, and PubMed, and the time considered is more than the Raju and Patil[27], i.e., from January 2020 to 23rd May 2020. From the above research, it is also evident that the outreach. The granular parameters of BS draw up research exhaustively as compared to the general parameter study is concerned. With the help of granular metadata, we have analyzed the BS of COVID-19 research papers elaborately through mediums: articles, conference papers, review papers, data papers, etc. The primary communication medium is articles, almost for all 39 research papers considered. One of the significant explorations from this research is studying COVID-19 from different subject areas like medicine, business, management, virology, molecular biology, infectious diseases, epidemiology, etc. The most productive research area is virology in the majority of research articles that were studied. The most productive author in BS is Yuen, KY. He is the world's renowned microbiologist, physician, and surgeon, affiliated with the University of Hong Kong. The significant contribution of Yuen KY led the research team to discover SARS-COV-1 in 2003. He has also been involved in SARS-COV-2 and the first person to advise people to wear the mask before the outbreak. Measuring a country's research impact depends on various parameters like the number of research papers published, the number of citations received by academic organizations, etc. Among the 39 research papers considered for this study, most of the research papers like Jia et al.[34], Belli et al.[29], Zhai et al.[32], Zhou et al.37], Ram[38], Viedma et al.[28],

Dehghanbanadaki et al.[26], Joshua and Sivaprakasam[40], Ali et al.[44], Ram and Nisha[48], Deng et al.[49], and Klingelhöfer et al.[57] found the University of Hong Kong is the most productive organization in the world. In this study, the USA and China are the most productive countries contributing 14 and 10 research papers in BS of COVID-19 respectively. The most productive source is the Journal of Virology that has published more scholarly research papers on BS than other sources. The reason might be the journal is very much related to viruses and virus-like agents, and the frequency of the journal is bi-weekly. Furthermore, the journal is indexed in reputed citation databases like SCI, Medline, etc. The keyword research is one of the most crucial research areas in bibliometrics study because it helps identify the core and related research areas. The most frequently used keywords in this study are COVID-19, coronavirus, SARS-COV-2, pneumonia, etc. The quality of a good research article is crucial for obtaining authenticated information and ideas about a particular field. In scholarly research, we lack the standard technique to measure the quality of research. The BS uses the quantitative approach to measure research quality in scientific research using its number of citations. In this study, Ksiazek, TG et al.(2003) document has received the most citations related to COVID-19. From the above study, we have found that significant research happening these days is collaborative. The collaborative research network can be drawn using different parameters like author, country, keywords, documents, organization, and sources to analyze research significantly. From this study, we have found that most of the collaborative network studies like Joshua and Sivaprakasam[40], Tanrýverdi et al.[42], Abideen et al.[43], Gautam et al.[45], Fan et al.[50], Akhter[51], Klingelhöfer et al.[57], and Warin[58] performed co-author network studies. There are a significant amount of collaboration networks using country, keywords, organization, and journals, etc. The advantages of this type of study depict the nature as well as strength of research.

10. Conclusion

COVID-19 pandemic has severely affected the whole world in a way no one ever thought out. The world was put on lockdown but the research community was constantly putting efforts to gain more knowledge about the virus. The research community carried out experiments for vaccine invention which led to an enormous amount of publications in the field of COVID-19. Here we have tried to summarize the BS which were related COVID-19. The 39 BS were performed from different points of view hence its purpose varied but it was seen that the journal *Library Philosophy and Practice* had published six *among these 39 BS*. It was

observed that various medical literature oriented databases like MEDLINE and even general databases like WOS, SCOPUS which cover a variety of subjects, were used for the studies. Data was collected using a variety of strings, with a different time-span (50 years, 20 years, 3 months, etc.) in various formats like CSV, XLS, BibTxt, txt, etc. To process, analyze, and visualize the data various software were used like Excel, Python, SPSS, VOsviewer, CiteSpace to name a few. The number of articles varied from 89 to 23,380 because of the number of databases, purpose, time-span and even the string used for the study. The most dominant document type was article and most productive subject area was medicine or virology. In 13 studies, it was observed that the University of Hong Kong was the most productive organization, and Yuen Kwok-yung was their most productive author(6 of them). 20 BS found the most article producing countries was USA, whereas 13 found China to be the most prolific. 8 BS found *Journal of virology* as the most producing source whereas 3 BS found *Journal of Medical Virology* as the most producing source. COVID-19 was the most prominent keyword whereas Ksiazek TG, 2003(5 BS) and Huang et al. 2020(4 BS) were the most cited articles according to the present study. For the collaboration network various elements authors/countries/organizations/keywords/co-citations/citations were used to create the visualization network. This particular study shows that in a particular field we can approach bibliometric assessment from various points of view and the results will be very different as well. This study also allows us to summarize the existing literature on BS in any field concisely.

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